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EXPERIMENTAL STUDY ON INVESTIGATION OF SIC IN GLASS FIBRE REINFORCED LAP JOINT

R. GANESH, A. MANIMARAN & K. LOGESH

Department of Mechanical Engineering,

Vel Tech Rangarajan Dr. Sugunthala R & D Institute of science and Technology, Avadi, Chennai, India

ABSTRACT

Composite materials have been used in several fields like aerospace structures, marine industries, automobiles and armed vehicles. It serves as an appropriate alternative to metals because of its high strength to weight ratio of composites. Most of the current structures use composite materials and its structural design includes the joint strength. Filler materials are the inert materials which are used in glass fiber reinforced polymer (GFRP) composites for modifying the chemical and physical properties of the matrix polymers to reduce material cost. Some of the commonly used fillers are carbon black, calcium carbonate, clay, alumina trihydrate, magnesium hydroxide, bone powder, coconut powder, hematite powder, TiO2, SiO2, ZnS, graphite, etc. In this research, the lap joints fabricate from unidirectional ply and Bidirectional ply of glass fiber reinforced composite with filler materials SiC specimens are subjected to mechanical properties tests.

KEYWORDS: GFRP, Lap Joint, Glass Fiber, Tensile Test & Flexural Test

Original Article

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INTRODUCTION

To reduce material costs in composite materials, filler materials are generally used to improve mechanical properties and to improve processability and product performance. Composite materials are formed by combining two or more different materials with different material properties [1-4]. Fiber's when embedded with weaker matrix materials comprise of strong load carrying capacity [5-8]. The fibers in the composite materials will improve the mechanical properties such as tensile strength, flexural strength, impact strength, stiffness and matrix will transfer stresses between the reinforcing fibers [9-10]. Fiber reinforced polymer composites are also called as fibrous composites because they consist of fibers by means of the reinforcing materials. The applications of composite materials are in Automotive, marine, aerospace, etc. because of its high specific strength and stiffness [11-12].

The two types of composite materials are metal matrix composites, ceramic matrix composites and polymer matrix composites. If the material is ceramic, it is called ceramic matrix composite. The properties of ceramic matrix composites are robust, high strength, rigidity, high-temperature properties and better wear resistance. If the material is polymer resin, it is called polymer matrix composite. The properties of polymer matrix include low density, thermal and electrical nonconductor. Polymers are classified into thermoplastics and

thermosets.

SELECTION OF MATERIALS

Silicon Carbide

Silicon carbide (SiC), is a semiconductor which contains silicon and carbon and it presents in nature as the exceedingly rare mineral. Silicon carbide composite is a kind of ceramic composites, which is made up of ceramic particles and it is used in gas turbines to replace metallic alloys. Silicon carbide composite, includes SiC matrix and fiber that are combined together by processing methods.

Mechanical properties

The mechanical properties of ceramic composites can differ based on the fiber used, matrix and interphase. Because the size of the fiber, composition involved and configuration of the fibers decide the properties. The failure mechanism of the composite controls the interaction between matrix and fiber, which makes it not brittle.

Properties of Epoxy

Epoxy is cheaper and faster than welding. Epoxy is an excellent resistance to chemicals and heat. There is no need to worry about the chemical reaction that occurs after setting. It has higher mechanical strength and low curing contraction. Epoxy resins are well-balanced industrial material and used for a broad range of applications.

E-Glass Fiber

Glass fibers are produced by melting the glass into a platinum, the process is called as melt spinning method which allows the molten glass to flow through the small holes. The fibers are extracted from the holes which is then twisted into the spindle and they are cut to length using air jet.

Typical properties of E glass fibers

- The tensile strength of E-Glass is 2000 MPa
- The density of E-Glass is 2.55 g/cm^3
- The young modulus of E-Glass is 80 GPa

MANFACTURING TECHNIQUES OF POLYMER MATRIX COMPOSITES

Hand Lay Up Process

It is a distinctive process of preparing thermosetting polymer matrix composites. The forming process of composite materials includes compounding of fibers and resins.

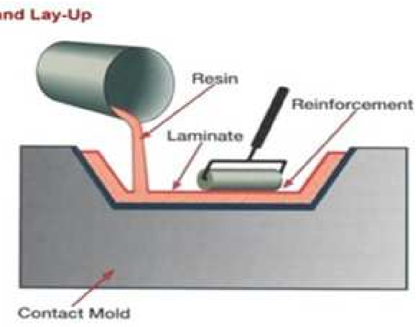

Figure 1: Hand Lay-up Method

EXPERIMENTAL WORK

Preparation of Specimen for Tensile Test

Tensile strength is defined as the resistance of a material to breaking under tension.

On MCS 60 UTE-60 machine tensile test was performed.

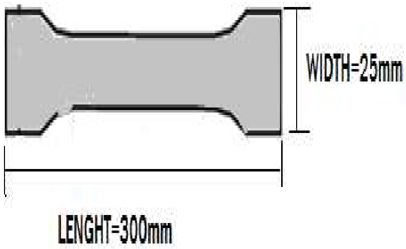

Figure 2: Normal plate

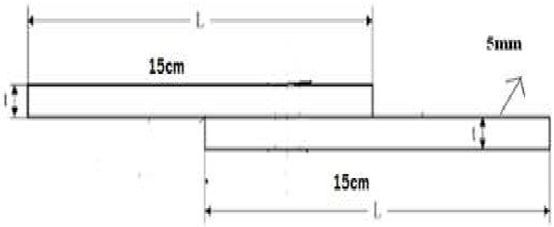

Figure 3: Lap joint

Preparation of Specimen for Flexural Strength Test

Flexural strength is generally the bending strength which is performed to measure the rigidity of the material. By using a universal testing machine called UTE-60T, the experiment was carried out for the specimen size as per standards.

Flexural Strength Equation

The equation for Flexural strength is 3PL/2bd2

Where,

P= maximum load applied to the specimen

b = specimen width

d= specimen thickness

L=specimen range

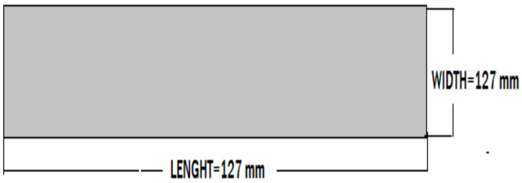

Figure 4: Normal Plate

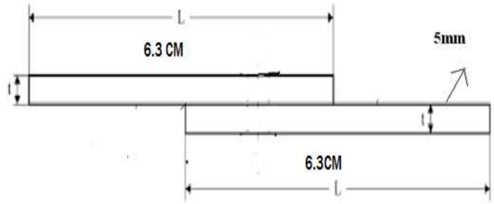

Figure 5: Lap Joint

RESULTS AND DISCUSSIONS

A composite material which has been made using the above composition was tested for finding the tensile test and flexural strength test and the results are shown below in table 1 which expresses the results of the tensile and flexural test of GFRP [11-12].

Table 1: Tensile and Flexural Test Results of GFRP

Mixing Ratio	Tensile Strength in MPA	Flexural Load in KN
SiC(0%)	68.31	0.32
SiC(5%)	103.44	0.72
SiC(10%)	61.21	0.43

Composite material lap joint specimen in different composition was tested for finding the tensile test and flexural strength test and the results are shown below in table 1 which expresses the results of the tensile and flexural test of GFRP lap joint.

Table 2: Tensile and Flexural test result of GFRP Lap joint

Mixing Ratio	Tensile Strength in MPA	Flexural Load in KN
SiC(0%)	7.77	0.74
SiC(5%)	14.80	0.52
SiC (10%)	4.53	0.44

Graphical Representation of Tensile and Flexural Strength Test

Graph for GFRP with 0% of SiC

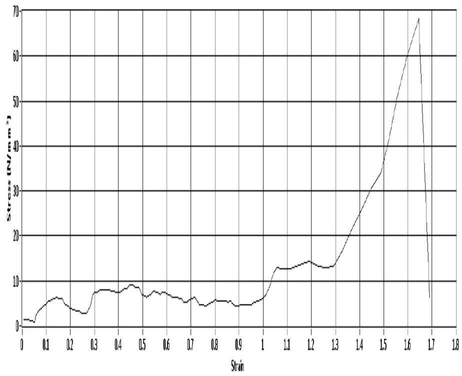

Figure 6: Stress Strain Curve For Tensile Test

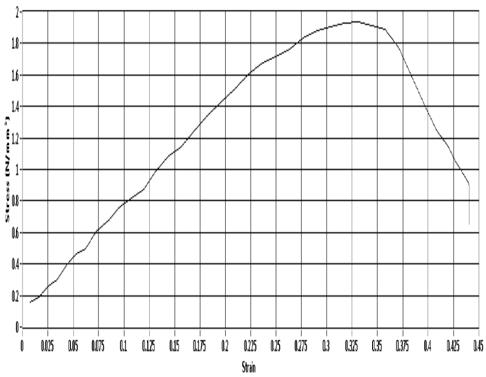

Figure 7: Stress Strength Curve For Flexural Test

Graph for GFRP with 5% of SiC

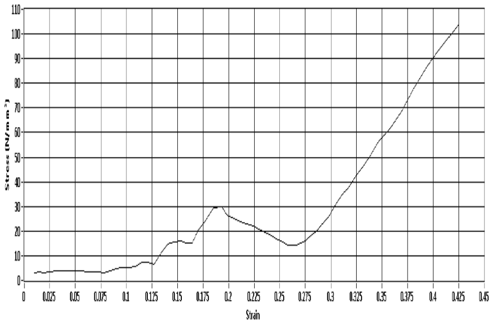

Figure 8: Stress Strain Curve for Tensile Test

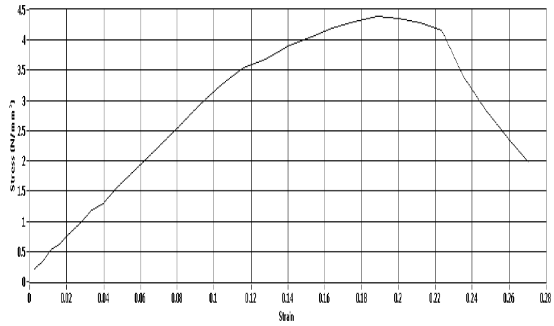

Figure 9. Stress Strength Curve for Flexural Test

Graph for GFRP with 10% of SiC

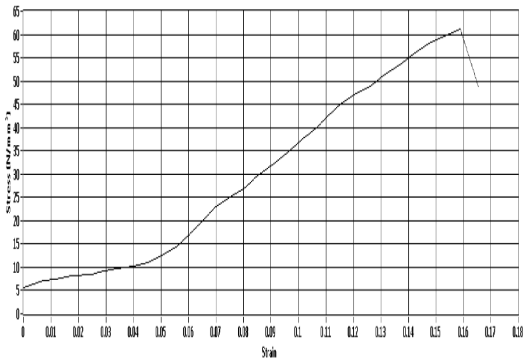

Figure 10: Stress Strain Curve for Tensile Test

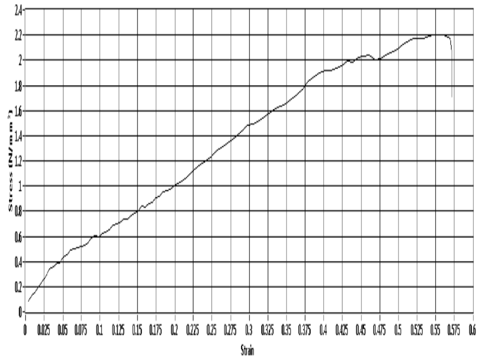

Figure 11: Stress Strength Curve for Flexural Test

Graphical Representation of GFRP Lap Joint

Graph for GFRP Lap joint with 0% of SiC

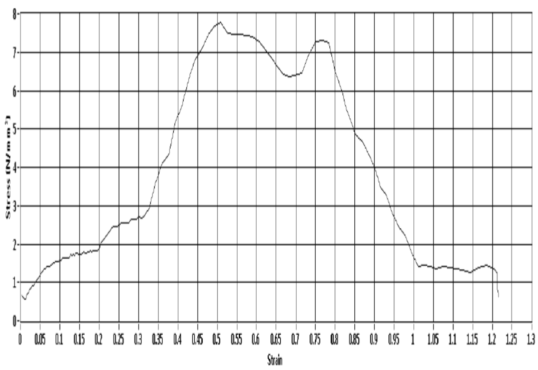

Figure 12: Stress Strain Curve for Tensile Test

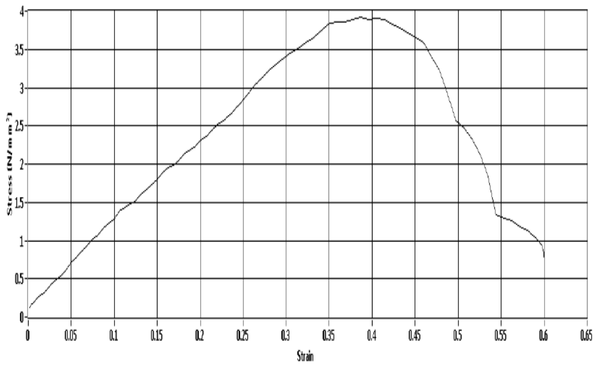

Figure 13: Stress Strength Curve for Flexural Test

Graph for GFRP Lap joint with 5% of SiC

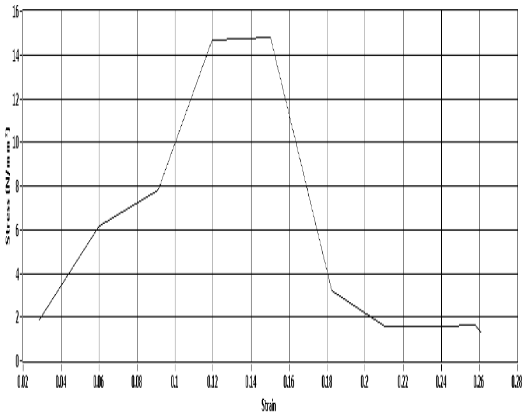

Figure 14: Stress Strain Curve for Tensile Test

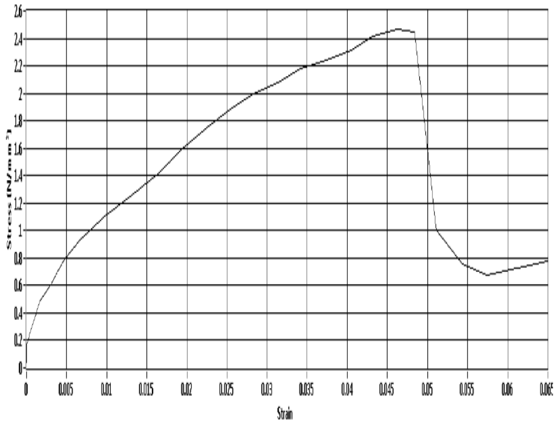

Figure 15. Stress Strength Curve for Flexural Test

Graph for GFRP Lap Joint with 10% of SiC

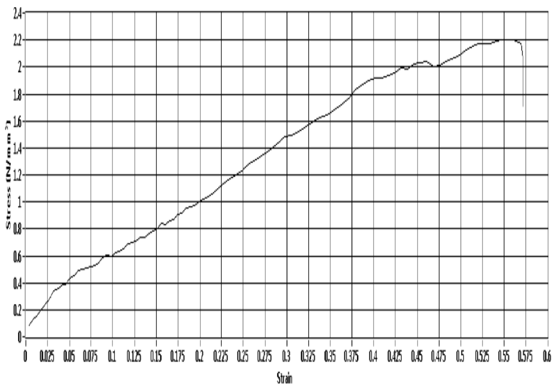

Figure 16: Stress Strain Curve for Tensile Test

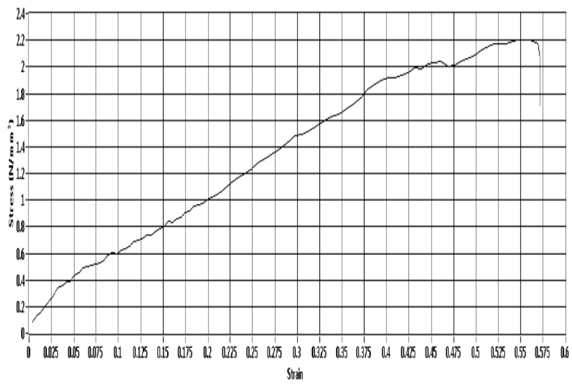

Figure17. Stress Strength Curve for Flexural Test

CONCLUSIONS

In this project Glass fiber (Unidirectional and Bidirectional composite) along with 10 % SiC was fabricated by hand lay-up method. The composite material was machined according to the dimension. The Experimental l results for glass fiber (Bi- Directional Ply) with SiC (0%, 5%, 10%) epoxy composite are obtained. From this project, it can be observed that the tensile strength and flexural value of 5% of SiC GFRp were maximum of 103.44MPa and 0.72KN respectively, when compared with other compositions (SiC (0%, 10%) Then the tensile strength of the for 5% of the SiC GFRP lap joint is a maximum of 14.80MPa with other compositions And the flexural strength of SiC (0%) is a maximum of 0.74 KN. Based on the tensile and flexural values, GFRP with 5%, 0% SiC compares with 10% of SiC is used in Aircraft and Automobile application.

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